PHYSICAL AND CHEMICAL PROPERTIES OF BURGERS MANUFACTURED WITH DIFFERENT LEVELS OF CAMEL MEAT

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ABSTRACT

This study was conducted to investigate the effect of using different levels of camel meat and storage time on properties of burgers. 25kg of meat (12.5 kg camel and 12.5kg beef) were used. Five levels of camel meat were used 0% (pure beef, control), 25%, 50%, 75%, 100% and two storage periods 1 and 7 days at -10℃. Chemical composition, cooking loss, water holding capacity, objective color, ultimate PH, oxidative rancidity and sensory evaluation were determined. Data were statistically analyzed using analysis of variance pertaining to factorial arrangement by SPSS version 10.05-computer program.

The results indicated that statistical analysis revealed no significant interaction difference between the levels of camel meat and storage periods except for protein, fat, ash, PH, WHC and color (L).The chemical composition was significantly ($P<0.05$) different between the two types of meat studied. The moisture percent, PH and WHC were higher while protein, fat, ash and cooking loss percentages were lower for camel meat in comparison beef. Colour of fresh camel and beef muscle were significantly different ($p<0.05$). Camel meat had more lightness (L), redness (a,) and yellowness (b,) values than beef meat.

Increasing the level of camel meat resulted in a highly significant ($p <0.05$) increase in moisture percentage and significant decreased in oxidative rancidity (TBA-values).TBA value decrease was not significant ($p>0.05$) between levels 25%, 50% and 100% and also between levels 0 and 25%. Moisture% decreased significantly ($p<0.\ 05$) and oxidative rancidity increased significant ($p<0.001$) with increasing the storage period to 7 days. Protein, fat and ash percentage decreased significantly ($p<0.\ 05$) while PH, WHC increased slightly and significantly ($p<0.05$) with increasing both of the level of added camel meat and storage period.

With the exception of levels 0 and 100% cooking loss of burgers from different levels of camel meat were not significantly different ($p>0.05$). Cooking loss and shrinkage decreased significantly ($p<0.001$) while oxidative rancidity increase significant ($p<0.001$) with increasing the storage period.

Color co-ordinates a-(redness) and b-(yellowness) increased not significantly ($p>0.05$) but panel scores for, tenderness, flavour, juiciness and colour increased significantly ($p<0.05$) with increasing level of camel meat. Redness (a) decreased and yellowness increased significantly ($p<0.05$) but tenderness and colour decreased, flavour and juiciness increased slightly not significantly ($p>0.05$) with increasing the storage period at -10ºC. Lightness (L) increased ($p<0.\ 05$) with increasing both level of camel meat and storage period.

الخلاصة

اجريت هذه الدراسة بغرض التحقق والتعرف علي اثارو مميزات استعمال مستويات معينة من لحوم الابل وفترة التخزين في صناعة البيرقر،استعملت 25كجم من اللحم (12,5كجم لحم بقر،12,5كجملحم ابل) اجريت التجربة علي خمسة مستويات من الخلط بين لحوم الابل والابقار مع اعتبار درجة 0% من لحوم الابل (محدد) 25،50%،75%، 100% مع التخذين المبرد في درجة حرارة -10م بالنسبه الي اليوم الاول والسابع. لقد تم اجراء التحليل الكيميائ ،فاقد الطبخ، قابلية حفظ الماء ، اللون، درجة الحموضة، التذرنخ والتقيم الحسى، وثم تحليل النتيجة عن طريق

analysis of variance pertaining to factorial arrangement by SPSS version 10.05-computer program.

لقد اعطت نتائج التحليل الاحصائ انه لاتوجد فوارق معنوية في التفاعل بين المستويات المختلفه للحوم الابل وكذلك التخزين المبرد ماعدا في حالات البروتين،الرماد ،درجة الحموضة، قابلية حفظ الماء واللون.

التركيب الكيميائ يختلف معنوي (P<0.05) بين النوعين من اللحوم ، في النسبه المئوية للرطوبه، درجه الحموضة ،قابلية حفظ الماء واللون الفاتح (L) كانت اعلي في لحوم الابل،كما ان البروتين، الدهن، الرماد،فاقد الطبخ اقل في لحوم الابل.لون لحوم الابل الطازج والابقار يختلف معنوى .(p<0.05) ، لحوم الابل لها اعلي درجة في اللون الفاتح (L) الاحمر (a) والاصفر (b) مقارنة بلحوم الابقار.ان اضافة لحوم الابل نتج عنه ذيادة معنويه (p <0.05) في كل من الرطوبة وانخفاض في التذرنخ (TBA-values) ،ان نسبه التذرنخ تنخفض غير معنوي (p>0.05) بين مستوي 25% ،50% ،100% وايضا بين مستوي 0% و25% ،والتذرنخ يذداد معنوي (p<0.001) مع زيادة فترة التخزين لمدة اسبوع في درجة حرارة -10م ،الرطوبه النسبيه تنخفض معنويا(05 .p<0) ، ان نسبه البروتين،الدهن، والرماد تنخفض معنوي (p<0.05) بينما درجة الحموضة ، قابلية حفظ الماء تذداد خفيفا ومعنويا (p<0.05) مع ذيادة مستويات لحم الابل وفترة التخزين، باستثناء مستوى ال0% و100% نجد فاقد الطبخ من النسب المختلفة من لحوم الابل لاتوجد بها اختلافات معنوية(p>0.05) . فاقد الطبخ والانكماش ينخفض معنوي (p<0.001) بينما التزرنخ يزداد معنوي (p<0.001) مع ذياده فترة التخزين.اما اللون الاحمر(-a) والاصفر (-b) يذداد لاكن غير

معنوي ($p>0.05$).التذوق الحسى لكل من الطراوة، ، النكهة ، العصرية واللون تذداد معنوي
($p<0.05$) مع ذيادة لحم الابل.اللون الاحمر (-a)) ينخفض واللون الاصفر (-b) يذداد
معنوي ($p<0.05$)لاكن الطراوة واللون تنخفض، النكهة والعصيرية تذداد ذيادة خفيفة لاكنها
غير معنوية ($p>0.05$) مع ذيادة فترة التخزين في درجة حرارة -10م.اللون الفاتح (L) يذداذ
معنوي ($p<0.05$) مع اضافة لحم الابل وفترة التخزين.

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CHAPTER ONE

INRTODUCTION

Camels are an important livestock species uniquely an adapted to hot and arid environment. One third of total Camel population is in Somalia and 60% within the borders of Somalia, Sudan, Kenya and Ethiopea. Camels entered Australia by colonial time as a loading animal but now Australians started to look at it as source of meat (*Brain J, 2005*). They are capable of walking for long distances about 40km / day for searching for pasture and water. They can stay for weeks without watering during the rainy and winter seasons. During summer, they need to be watered every 3-5 days (SPRC, 2002). They fed on grasses, shrubs and trees which enable it to survive and utilize the poor environmental condition to produce meat and milk. During the last two decades the world Camel population increased by approximately 40% (*FAO, 1986*).

The export of camel meat is now creating interest for the international meat industry. Comparative technical information shows that the fat content of camel meat is considerably less than beef, low in cholesterol and high in protein. Camel meat is similar in taste and texture to beef (*Williams, 2002*). As a meat-producing animal, its dressing percentage range from 46-55% (*Willomson and Payne, 1978*).

The urban populations in Sudan are not well accustomed to eat camel meat so most of the camels were exported to Egypt, Lybia and Gulf state (*Elamine, 1979*).

Due to the effects of desertification, many of agropastorlist in Northern Kordofan and Darfour started to raise camels in place of cattle due to their ability to with stand hard condition, thus more consumption of camel meat will be expected.

Recently, due to desertification and the environmental changes large groups of rural population moved to the areas around the big towns searching for work and better life.

These new settlements created good markets for camel meat. Processing of camel meat into sausages and burgers can improve its palatability and hence encourage urban population to consume more of it. Increase individual income leads to increased demands not only for staple food but also for preferred foods including particularity meat and meat products. Increasing population and increased growth income in the third world 1961-1965 and 1973-1977 meat consumption grew at an average rate of 3.4% and in the fast growth economies at more than 6% (*Sarma and Young, 1985*). Meat consumption between countries varies from 4kg per person per annum to 35kg in high income groups (*Arnold Bender, 1992)*

Objectives:

1/ To determine chemical and physical properties of burgers manufactured with different levels of camel meat

2 / Utilization of camel meat to alleviate animal protein shortage due to increase prices of red meat from other species.

3/ To improve the eating quality of camel meat by processing it into meat products.

CHAPTER TWO
LITERATURE REVIEW

2:1 Introduction

Meat is essential food for human growth and development. It provides the body with proteins, good source of essential amino acid, vitamins and to a lesser extent of certain minerals and fatty acids (Pellet *et al*, 1990). Meat provides calories from protein, fat and the limited quantities of carbohydrate present (Judge *et al*, 1990). Meat having a high percentage of collagen will also have relatively lower intrinsic nutritive value (Lawrie, 1991). Meat is usually sold fresh to consumers in the Sudan due to lack of advanced technology of preservation and processing.

2:2 Camel Live and Carcass Weight

In the pastoral communities camel meat is only eaten on special occasions such as festal gatherings and following the return of the herd from seasonal grazing (Hartly, (1979). The live weight of male and female camel differ in different countries. In Somalia desert camels live weight about 350-400kg (Knoess , 1977). While the heaviest live weight, 660kg, was reported from Indian pack camels. Slaughter weight of mature well finished male camel range between 395-512kg with a mean empty body weight of 404.8kg. In Sudan, Southern Darfour camels have live weight between 395-465kg and dressing percentage of 51.4 in males and 47.4 in female. The dressing percentage of Sudanese male camel was 56.6kg on warm carcass and 55.8 kg on cold carcass bases. Camel carcass of 251kg average cold weight was found to be composed of 56%

muscle, 19% bones, 13.7% fats and 7.5 trimming (Yousif and Babiker, 1989). These finding were higher than those reported by (Wilson, 1978). The hot average carcass weight of camel ranged from 50 to 55 percent of the animal's body weight (Al-Qadi, (2007). It could be differed according to breed, area, age and the quality of nutrition used to feed the animal.

2:3 Chemical composition of Meat

The nutritive value of meat was attributed to its protein, fat, carbohydrate, vitamins and mineral content (Judge et al, 1989). In proximate composition meat contains 75% water 19% protein, 2.5% lipid and 8.5% minerals. Inorganic component such as Phosphors, Potassium Sodium and trace element constitute 1.0% of the fresh muscle weight (Judge *et al*, 1989). The moisture was higher in Camel than beef but fat was lower than beef (Babiker and Tibin, 1986)

The protein of typical mammalian muscle after rigor mortis but before postmortem degradative changes contains about 19% crude protein, 11.5% structural protein actins and myosin (myofibril), 5.5 soluble sarcoplasmic proteins in the muscle juice, 2% connective tissue, encasing the structural protein fibers (Judge *et al*, 1990**).**

The chemical composition of camel muscles Longissmus drosi (Lumber part), Semitendinosus and Triceps brachii obtained from mature well-finished desert were studied by Babiker and Yousif,(1990). They reported that the moisture percentage was (75.89), (75.81) and (75.23), the protein percentage was (21.63), (21.41) and (21.41), the fat percentage was (1.43), (1.40) and (1.42) and the ash percentage was (1.05), (1.38) and (1.22) for the three muscle respectively. The Variation in chemical and biochemical constitutions of muscle are affected by different factors such as bread, sex, age, species, and anatomical location of muscle and plane of nutrition (Lawre, 1991). Chemical composition of camel meat compared with the other species, beef, lamb, goat and chicken showed more moisture, less fat and ash and more or less similar protein. (Elgasim, et al, 1992). The proximate composition, amino acid and inorganic mineral contents of Arabian camel (comelus dromedaries) meat were investigated and compared with other red and white meats (beef, lamb, goat, chicken and fish) (Elgasim, E.A.; Alkanhal ,M.A; 1992). Meat of young camel (less than 5 year of age) had a higher moisture content 78.27% than that of older animals 76.24%. L. dorse muscles had the highest content of collagen compared to the other muscle.) Myoglobin is present in relatively large quantities in heart muscle because of heavy oxygen demand, the highest amount of myoglobin in mammals is found in whale to permit prolonged submersion under water (Bender, 1992).

The moisture content of fresh slice camel meat ranged from 76.11 to 79.18% with an average about 78.46% (Suad, 1994). The chemical composition of camel meat and found that the moisture% range was 68.8-76.0%, the protein% 19.4-20.5, the fat% 4.1-10.6 and the ash % was about 1.5%. (Dawood and Alkanhal, 1995) The chemical composition of camel meat was 79.0% moisture, 20.19% protein, 2.49% fat and 1.30% ash (Saliha, 2001). (Fathi El-rhmanr, 2005) compared the chemical composition of camel and beef meat and found that camel meat had higher moisture content (75.78%) and protein (22.05%), lower fat (1.36%) and ash content (1.06%) in compared with beef muscle moisture (73.85%), protein (21.96%), fat (2.99%) and ash content (1.39%) . (Isam et al, 2006). The moisture content of camel and beef were 70.6 vs. 72.1% protein 21.8% vs. 22.0%, fat 5.8% vs. 7.8% and ash 1.2% vs. 1.5% respectively. Camel and beef contained 27.9 vs. 19.4 Calcium, 41.0 vs. 66.1 Magnesium; 180.9 vs. – 226.4 Sodium; 762.2 vs. 1326 Potassium; 416.9 vs. 522.1 Phosphorus; 0.215 vs. 0.030 Chromium; 0.101 vs. 0.153 Nickel; 0.040 vs. 0.021 Molybdenum and 0.014 vs. 0.018 Vanadium mg/100g on dry matter basis, respectively. Camel meat has a lower fat content and higher level of moisture compared to beef; in addition it is rich in minerals (Al Qadi, 2007).

Camel meat had more moisture, less fat, less ash and similar protein contents to beef, lamb, goat and chicken. The highest moisture and the lowest protein contents were found for fish (Epinephulus chlorostigma). The moisture to protein ratio of the camel and fish were higher than those of beef, lambs, goats and chicken. Except for Na, camel had a similar elemental composition (Zn, ca, k, mg, cu and mn) to beef but was superior to that of fish. The major fatty acids in camel meat were palmitic (26·0%), oleic (18·9%) and linoleic (12·1%), with smaller amounts of other fatty acids, both normal and branched. that range in chain lengths from C14 to C22. The fatty acids of dromedary fat were dominated by saturated even-numbered chains with smaller amounts (5·4%) of add-numbered normal and branched chains. The main fatty acid of the one and two hump fat is Palmitic (34·4%) followed by Oleic (28·2%), Myristic (10·3%) and Stearic (10·0%) (Tarik N. Rawdah, 2003).

2:4 Carcass characteristic of Camel meat

Camel carcass consists of approximately 53-77% meat, 4.8% fat and 16-38% bones. 76% meat, 12% fat and 20% bones for both male and female respectively (Kurtu, 2004). Fat is an important constituent of processed meat products and makes large contribution to their tenderness, juiciness, palatability, structure and stability of butter type products (Judge *et al*, 1989; Savic 1985) .The total fat of the animal body is distributed into kidney knob, channel fat, subcutaneous fat, intramuscular fat (marbling) and intermusclar fat.

Naser *et al* (1965) found that moisture and ash content of the fat depot in the hump and around the kidneys increase with age, while the crude fat percentage decrease. They noted that in all ages the fatty tissue around the kidney contains a higher percentage of crude fat than do the hump. The meat of the camel contains significantly less lipids (1·2–1·8% versus 4·0–8·0%) and higher water content (5–8% more) than beef. The hump consists mainly of lipids (86·9%) (Zamil, *et al,* 2003). . The saturated fatty acids in the hump fats accounted for 58.3, 67.6, and 63.0% of the total fatty acids for groups 1, 2 and 3, respectively. (Kadim.I. T. 2001/2002).

2:5 Camel meat products

Camel meat provides excellent basis for various manufactured and cured meat. The conversion of camel meat to sausage eliminated toughness and reduced the required cooking time (Sadek, 1966). The color of meat product depends mainly on concentration of muscle pigment and curing agents used in meat products such as sodium nitrite and common salt (Saffle, 1968 and Bennion, 1980).The phosphate combinations increased the relative binding characteristics of sausage product (Swift and *et al,* 1957).

The emulsion type sausage camel with 10 and 15 percent fat were acceptable to the panelist and no significant difference between the camel and beef sausage and therefore camel and beef meat can replace each other in sausage manufacturing (Ibrahim and Babiker, 1989). During aging camel meat had been tender, and all the quality attributes flavor, juiciness, color and overall acceptability were improved significantly (Saliha, 2001). There is no difference between camel meat and beef frankfurter due to using different type of fat (corn oil, camel kidney fat and camel intramuscular fat) Vacuum packaging improved keeping quality characteristics compared with atmospheric packaging (Fathi-Elrhman, 2005)

2:6 Meat qualities

Meat quality is a term used to describe a range of attributes of meat (Maltin *et al*, 2003). Color and firmness are the most determinate factor of meat presentation and appearance while tenderness, juiciness flavor and aroma are the most characteristics influencing acceptability. The optimum and economical age for slaughtering camel is 2-3 years, with increase in age the meat become tough and its quality deteriorates. An average carcass weighing 210kg would yield 10 kg fat, 160kg meat and 40kg bones (Dkhanna, 1999).

Color is primary attribute affecting acceptability of meat and product by consumer (Trout, 1991). Fresh meat color is related primarily to the amount of haem pigments.

Camel competed favorably with other livestock regarding yield and quality (Mukass, 1991). The quality of meat produced by younger animals five year or less was comparable to beef in taste and texture, camel meat as palatable but coarser than beef and vary in color from raspberry red to brown red and having white fat (Leupold ,1986).

(Dahl and Hjort, 1976) found that camel can be slaughtered between four to ten years. Quality is combination of physical structural and chemical characteristic of meat which resulted in maximum desirability (person, 1960).

2:7 Color of Meat

Meat color is an important criterion especially for consumers (Harisn *et al*, 1980). The color of meat is related to the level of pigmentation (myoglobin) present in the muscle (Bennion, (1980). When meat is exposed to air the myoglobin react with oxygen and becomes oxidized and change to brown color(Judge *et al*, 1989).Generally, the brighter red color of fresh camel meat may affect the acceptability of camel meat and products by consumers. These were supported by (Trout, 1991) who observed that consumers expected fresh beef to be bright red to pink color.

High plane of nutrition and diet low in iron both leading to low myoglobin concentration of pigments in meat (Lawrie, 1991). When beef is cut the myoglobin oxidizes, giving rise to a bright red color and a process know as "blooing" If beef is left exposed to air for prolonged period, its color changes slowly to brown due to convert ion of myoglobin to met myoglobin (Bennion, 1980) Also redness (myoglobin concentration) increases as an animal matures and with exercise (Muir, et al 1998). A high level of pre-slaughter stress can lead to a rise in pH, which results in dark colored beef (Moloney, 1999). The principle pigment of cooked meat is known as globin haemichromogen. Camel meat color varied from raspberry red to brown red, according to the variation associated with muscle location.. Camel L.dorsi had more lightness (L) and significantly different more redness (a) and yellowness (b) values than Semitendinous and Triceps brachii muscle (Babiker and Yousif, 1990). Also noted that Camel muscle had more color lightness (L 32-35), redness (a 19.15), and yellowness (b 15.85), than beef muscle (L 28.65), (b 18.45) and (a 15.55) (Fathi El-rhman, 2005). The color of camel meat sustains its redness up to five days of storage, It contains a higher level of "myoglobin" that interacts for a longer period with oxygen also he pointed out that the meats color should always be considered when buying it, for bright red pieces of meat show that it is fresh and obtained from a young animal (Al-Qadi, 2007).

2:8 Flavor of Meat

Camel meat is recognized having a similar flavor to that of beef. (Elard, 2000)

Meat flavor is complex stimulus to the human senses involving chiefly aroma, texture, temperature, ph, and taste. The over all flavor sensation may depend essentially on volatile compounds that comprise the more important part of the total meat flavor profile (Erocker 1984 and Lawrie, 1991). The flavor of meat can be associated with either the water in meat or the fat components of the tissue. (Lawrie, 1991).

As the fat content of meat increases, so doe’s flavor, thus beef from older animals is more intense in flavor than meat from younger animals

(Melton, S.L, 1990). Flavor is influenced by the deposition of compounds from the feed in the fat of the animal; the odour and taste of cooked meat arise from water or fat soluble precursors and by liberation of volatile substances pre-existent in the meat as pyrazings and several compounds containing sulphurs (Melton S.L, 1990). Prolonged storage under unfavorable condition may cause the development of proteolytic or putrid odor from protein decomposition, Sour or taint odors from microbial growth and rancid odor from oxidation (Judge *et al* (1990). The nitrous oxide developed during curing and involved in cured pigment formation of flavor compounds (Land man and Batzer, 1966). The phenolic compounds in smoked meat appear to be important and affected flavor (Droudt, 1963). Curing agents such as salt enhanced flavor and caused few changes in meat and cereal like aroma. Flavor is increased with fatness and is affected by age sex, and breed (Cole *et al*, 1960).

2:9 PH of Meat

In the living camel the pH of the muscular tissue is about 7.0 – 7.4 and decrease immediately after slaughter to 6.3 the pH changes after slaughter are largely due to differences in the amount of glycogen available for transformation into lactic acid (MC Loughlin, 1970). Beef muscle varied widely form ph 5.8-7.1, muscle surface cut during dressing fell much more rapidly in ph, and particular in beef fatty site fell from near ph 8. to7 , the ph of beef surface chilled to -3 fell more rapidly to lower final value than those at 5 (William ,1974). After slaughter the glycogen in muscle is converted into lactic acid causing a fall in ph from an initial value of ph 6.8-7.3 to about 5.4-5.8 at rigor mortis (FAO, 1991). The effect of pH value of three Camel muscles for tenderness and were reported that pH values of L.dorsi 5.80, Semitendinous 5.72 and Triceps brachii 5.69 (Babiker and Yousif , 1990). The pH changes take place continually in frozen foods, even during long period of frozen storage (Guingnot *et al*, 1992). The pH value of meat is important in relation to the changes occurring in water holding capacity during conversion of muscle to meat depending on the rate and extent of pH drop and degree of protein denaturation (Mendenhal, 1995).

The pH of bovine longissms dorsi muscle range from 5.40 to 5.49 (Page *et al*, 2001). Ph in normal muscle fall to 5.5 if the animal is stressed for long duration for any reason the glycogen concentration can fall to less than 0.6% (Lylen, 2005).

High ph meat has following feature:

Dark cutting meat, a coarse texture, high water holding capacity and reduced shelf life. (Lylen et al, 2005). The ph of living muscle is just above 7 in well fed and rested cattle with glycogen concentration from 0.8% to 1.0% when the animal is harvested.

The ultimate ph value of camel meat was higher 5.73 than beef meat sample 5.45 (Fathi-Elrhman, 2005). The changes in ph during freezing might be caused by the increase in concentration of soluble materials, by the subsequent precipitation of salt, and probably by the interaction of protein with ionic substance (Van den berg et al, 1961).

2:11 Cooking of meat

Cooking makes connective tissue tenderer by converting collagen to gelatin, which coagulates and tends to toughen the protein of the myofibril, these effects depend on time and temperature. Prolonged cooking time and relatively low temperature are thus justified for meat which has much connective tissue (Weir, 1960). There is increase in tenderness with increased solubilizaltion of collagen in braising ,but relatively little so fattening despite increased collagen solubility on roasting, (Paul, 1975). when ground beef is cooked, it changes in color from red to pink to brown (Hague et al, 1994).Patties cooked to 150^0f have been shown visually to be indistinguishable from those cooked to 160^0 f (USDA-ARS /FSIS,1998). recommended that consumers should use food thermometer to be sure that ground beef patties reach 160^0 f. Ground beef remaining pink at temperature above 160^0 f , this associated with the ph ,the level of pigment in the meat and fat content (Hague, ,1994). Thermometers may be used toward the end of the cooking time and inserted at least half inch into thickets part of the patty (USDA-ARS /FSIS, 1998). The ph, cooking, temperature, cooking method, processing procedures, packaging, and microbial growth have influence on pink or red color in cooked meat (Comforth, D.1995). That premature browning of ground beef patties occurs when the pigment are either in an oxymyoglobin or met myoglobin form prior to cooking (Lavelle, et al, 1995.). Patties cooked from the frozen state were less red than those cooked directly after processing (Vani, 1996), Cooking temperature 65^oc cause meat color changes gradually from deep red or pink to lighter and finally to grey or brown (Price *et al,* 1971)

2:12 Oxidative Rancidity Meat

Meat fats are susceptible to oxidation when they are exposed to the oxygen present in air, this result in the production of strong disagreeable odor and flavor in the cooked product, when these chemical reactions occur they constitute a defect referred to as oxidative rancidity. The unsaturated fatty acid are very prone to oxidation, even in meat in which most of the fat is saturated and the cell membranes contain phospholipids (Warriss, 2000).

The characteristic flavor and odour of oxidized fat is caused by the presence of low molecular weight aldehydes, acids and ketones that form during the oxidation and decomposition of the fatty acid molecules (Judge *et al*, 1990). Fat rancidity does not develop when moisture content is reduced to 1.5% but at such a level flavor and texture are likely to be seriously affected (Lawrie, 1990). Undesirable alterations may occur in dried meat when there is a high percentage of fatty tissue in the raw meat. The rather high temperature during meat drying and storage cause intensive oxidation (rancidity) of the fat and an unpleasant rancid flavor which strongly influences the palatability of the product (FAO, 1990). Dry Meat used in developing countries is usually derived from unchilled carcasses and rapid ripening processes occur during the first stage of drying as the meat temperature continues to remain relatively high (FAO, 1990). Dehydrated cured meat is especially liable to undergo oxidative rancidity because of the production of pro-oxidants during curing (Lawrie, 1990). Rancidity level was not significantly different among the sun-dried, salted and sun-dried spiced beef; these meat types were found to have similar levels of fat content (Ishag, 1998). Rancidity may also be avoided by gas-packing the dehydrated meat only a slight odor, like that of crab meat, is then apparent and the latter disappears during reconstitution and cooking (FAO, 1990). The poly unsaturated fatty acids present in cell membranes can react with oxygen to form fatty acid hydro-peroxides, these are unstable and break down into compounds, which can produce off flavor. The process is relatively rapid (1-2 days), and this lead to the rather stale rancid flavor referred to as warmed – over flavor (Sato and Hegorty, 1971; Kerter and Grosh, 1996). Frank furter made from camel with corn oil (treatment A) had higher (0.074) oxidative rancidity (TAB- value) compared with other fat (treatment B) camel kidney fat, (treatment C) camel intramuscular fat and (treatment D) fat kidney fat (0.062), (0.063) and (0.059) (Fathi Elrhman, 2005).

2:13 Water holding capacity of Meat

The ability of meat to retain its own or added water during application of some external force, (WHC) affected by several factors such as pH, species, age muscle type and function. (WHC) in meat is at a minimum at what is called iso-electric point of proteins. The iso-electric point is the pH at which all protein side chain groups are charged (Kinpe.C.L, 1992). The ISO-electric point of meat is the pH range between (5.0 - 5.4) which is also the pH of meat after it has gone through rigor mortis. When water holding capacity is reduced PSE meat has higher drip and cooking losses, although water holding capacity is increased or at normal the DED meat is suitable for Scalded/boiled sausages and other cooked products but it has poor beef flavor (FAO, 1991).

The (WHC) of three camel muscle) L.dorsi 2.8, Semitendinous 2.1 and Triceps brachii 2.32 reported by (Babiker & Yousif, 1990). The (WHC) of camel meat was superior to that of beef and that superiority explained adaptation ability of camel to its dry habitat (Babiker & Tibin, 1986).

Intrinsic differences in carcass muscle composition were reflected in the variation of quality attributes as (WHC) (Lawrie, 1991). The protein net work physically and chemically enhance the water retention by their capillarity and non covalent bonding (Acton & Dick, 1984) . Water retention in processed meat product is the major contributing factor to the sensation of juiciness (Hedrick *et al*, 1994). The loss of weight of processed meat products during processing is a function of the (WHC). The water holding capacity of camel muscle decreased from5.58 at zero hour to 3.72, 2.82 and 2.12 at 3, 5 and 7 days of storage (Saliha, 2001). The water holding capacity of camel meat (3.65) higher than beef muscle (3.25) (Fathi El-rhman, 2005).

2:14 Juiciness of Meat

The initial impression of wetness due to rapid release of meat fluids and longer action of fat on the salivary gland. Juiciness tend to be associated with marbling, hence heavier fatter animals produce beef, which seems juicy, Juiciness tends to decline as animal ages (Moloney , A.1999). The principle source of juiciness in meat as detected by consumer, are the intramuscular lipids and water content (Judge *et al*, 1990) .Tenderness and juiciness are closely related the more tender meat, more juicer the meat, juiciness varies inversely with cooking loss (Judge *et al*, 1990 The differences in juiciness were related primarily to the ability of muscle to retain water during cooking). (Judge *et al*, 1989). Juiciness in sausage was affected by the level of common salt and phosphate groups (MotoLock *et al*, 1984). Juiciness reaches minimum when the pH level of the meat is about 6.0, the ranking order shows that juiciness was greatest in the fresh (frozen) meat at high ultimate pH

(Lawrie , 1979). Juiciness is more highly associated with intramuscular fat (Romans *et al*, 1965; and Simon *et al*, 1961).

2:15 cooking loss of Meat

Cooking loss is one of the most important properties of emulsion type sausage products and it is related to water holding capacity (Lawrie, 1991). There are variations in water holding capacity among different types of meat from different animals and muscles, higher water holding capacity of meat decreased cooking loss in final product (Lawrie, 1991). Cooking loss is also affected by the muscle location (Lawrie, 1991). comparing in camel muscle cut L.dorsi (Lumber part), Semitendiosus muscle had significant lower cooking loss than L.dorsi and Triceps brachii muscle which concided with it is superior water holding capacity (Babiker and Yousif ,1990) Bulls well fattened fed high energy diets revealed improved water holding capacity and reduced cooking losses(Mohammed, 1999).

Camel meat samples have less cooking losses and higher water holding capacity when compared with beef samples (Babiker and Tibin, 1986). The level of fat used in sausage also affects cooking loss, the differences in cooking losses of emulsion type sausage manufactured from buffalo meat with 15.20 and 25% prok fat , the lowest cooking loss was observed in the 15% fat 7.9% and the highest cooking loss with 25% fat 10% (Krishan and Sharma, 1990).

Cooking losses increased as the salt level in the formulation decreased. (Sofos, 1983).

In addition, these losses increased with the use of lower binding quality meat, it is possible to reduce cooking loss by using binder indicated that binders such as dried milk used in different levels reduced cooking loss from 22% in zero level to 13% with 10% dried milk ,(Froning, 1966). The percentage of losses in cooking were affected by the level and type of fat in frankfurters, and was observed that increasing losses are correlated with decreasing content of fat in frankfurter prepared with cotton seed oil (Town et al, 1971).

Bull fed diets high in energy and high protein showed improved water holding capacity and reduced cooking looses than those fed on diet with low energy and protein levels (Ahmed, 2003) found that the effect of the different slaughter weights on meat produced in Western Baggara bulls ,he found that the water holding capacity of longssmus dorsi muscle improved significantly as the animal weight increased he was found that the cooking loss percentages for M.biceps femoris , M.longissmus dorsi, M. infraspinatus, M.triceps brachii , M . Psoss major, M .gluteus medius, M. rectus femoris , M .semimembranosus ,M .adductor , M .supraspinatus and M .semitendnosus were (18.7), (20.7), (20.7), (22.0), (23.6), (23.6), (24.4), (25.6), (26.9), (7.3),and (27.4%) in their studies of eleven beef muscles. Cooking loss of beef frankfurter 7.36% was higher than that of Camel meat frankfurter with different type of fat, cooking loss was (4.13) for treatment A (Camel meat with corn oil), (13.63) for treatment B (Camel with kidney fat) and (3.13) for treatment C (Camel with intramuscular fat**)** (Fathi El-rhman, 2005).

2:16 Tenderness and texture of Meat

Texture of meat involves all sensory manifestations of the structure of meat and the manner in which this structure reacts to the force applied during biting and specific senses involved in eating; it is how meat felt in the mouth during manipulation**.**

The Called tenderness an experience attribute has been shown to be the most important trait affecting beef acceptability "the one attribute that consumers most associate with eating quality"(NCBA, 2001). . Beef tenderness is one of the highest ranked beef quality concerns among beef packers, purveyors, resturanteurs, and retailers according to recent surveys (Smith *et al* 1995). Current USDA quality grading standards inadequately identify meat tenderness (Savell *et al* 1987). However recent technological improvement has made it possible to effectively segregate carcass into tenderness categories and to tenderize less tender meat (Shackelford &Koohmaraie 1996). Cautioned that the relation between breed and tenderness is not strong, since variation of tenderness within breeds is lager than variation across breed, "adirect measure of meat tenderness is needed to supplement quality grade" (Wheder, et al, 1994). Virinia Polytechnic Institute and State University have examined prerigor skeleted cuts (seporations) to improve beef tenderness (Wang *et al*, 1994; 1996; Ludwig *et al*, 1997; Claus *et al*, 1997; Beaty *et a*l, 1999). This procedure, sometimes referred to as the "tender cut process", has been tested on the longissimus muscle and sirloin and round cuts. Reasearchers have found tenderness improvements in the longissimus muscle, round, and sirlion, but greatest improvement has been shown in longissimus muscle, and for one cut location in round and sirloin region.

Two structural components have been shown to determine the tenderness of meat i.e. the collagen of connective tissue & the contractile apparatus of myofibril protein (Zaglul et al, 1987). The impression of tenderness to the palate include texture and involves three steps, firstly the initial ease of penetration of the meat by the teeth, secondly the ease with which the meat breaks into fragments, thirdly the amount of residue remaining after chewing, there have been objective physical and chemical methods of assessing tenderness which would compare with subjective assessment by taste panels. Physical methods include the basis for measuring the force in shearing, penetration, biting, mincing, compressing and stretching of meat. Chemical methods have involved determination of connective tissue and enzymic digestion (Lawrie, 1991), tenderness or toughness of meat is a quality representing the summation of properties of the various protein structures of skeletal muscles the sensation of tenderness may also be influenced by the juiciness of the meat, the water holding capacity of the protein, the amount and distribution of fat (Lawrie, 1991) .There are several methods to improve texture properties in meat emulsion type products. (Deatherage, 1963).

All binders such as phosphate, dried milk solid, gelatin and gluten flour increased texture, salt is also effective in improving texture and binding properties of processed meat , type of meat and ingredient of meat used in processed meat .There are relationship between tenderness and ph.PH is very important in the tenderization process, if meat , high final ph above (6.3) there is evidence that cal pains are most active resulting in more tender meat , while intermediate final ph (5.8-6.3) produced meat tougher than normal .(Troy et al, 1999) .

The lowest tenderness score for beef occurred on postmortem ph of 5.80-6.00, but tenderness improved as meat ph values increased to

7.00 (Lawrie, 1962) . It was also observed that beef tenderness decreased from ph 5.8-5.3 (Luckett et al, 1975).

2:17 over all acceptability

An evaluation of overall organoleptic properties depends upon the sensory evaluation of physical characteristics and mainly upon color and flavor, of final product, (Dockerty *et al*, 1986). The lean beef with 15% fat level was preferred by the panelists for texture and flavor; while lean camel meat with 15% fat level received the least score in color Lean beef with 10% fat received the best score in color and the least score in juiciness (Tibin and Babiker, 1986). Overall organoleptic properties of sausage manufactured from either beef or camel meat with different fat levels (Tibin and Babiker, 1986). Observed that all sausage were acceptable to the panelist for the different parameters measured. Camel meat resembled beef in taste (Kulaeva, 1964who noted that camel meat closely resembled beef in appearance, color, texture and acceptability. (Khatimi, 1970). The sensory quality of beef frankfurter produced with different fat or peanut oil levels, observed that frankfurters with 12% final fat content received lower rating for overall acceptability than the product with 20 or 29% final fat content, they also indicated that there were no difference in overall color or acceptability due to oil treatments Any factors affecting flavor will affect overall acceptability (Marquez *et al*, 1989). Curing agents such as common salt are important in enhancing flavor in sausage (Sofos,1983) The flavor and overall acceptability of frankfurter formulated with 2.5% salt were high and remain in the acceptable range through long period of storage, Products with 1% or

1.5% salt had lower acceptability in comparison to those with 2.5% salt (Sofos,1983).

2:18 Meat processing

Meat was originally processed for preservation but since the various procedures cause so many changes in texture and flavor it is also a means of adding variety to the diet (FAO, 1991). Processing provides scope to mix the less desirable parts of the carcass with lean meat and in addition, it is a means of extending meat supplies by including other foodstuffs such as cereal in the product. Thus, processed meats can be said to be products in which the properties of fresh meat, modified for production of intermediate moisture products and the use of additives resulting into flavor full, and nutritious products providing both convenience and variety (FAO, 1991). Thus processed meat contain variable amount of lean muscle, fat and connective tissue.

Different countries have different standards for processed meat (FAO, 1992). Processed meats are products in which the properties of fresh meat have been modified by the use of procedures such as mincing, grinding, chopping, and salting, curing, addition of seasoning and other food materials and in many instances heat treatment (FAO, 1992). The commonest meat processed products are sausages of which six type are most important Only well chilled or frozen meat is used at temperature of -2 to 5°C maintained during chopping to facilitate comminuting of lean and fatty tissue to the particle size desired and to avoid deposition of fat drops in the batter (FAO, 1992) Added salt prevents the growth of unwanted microorganisms and extracts salt soluble proteins to from a protein gel, which binds the pieces of meat together (FAO, 1992)Comminuted products are based on lean meat which technologically provides water holding and meat binding capacity with the addition of fatty meats. The ingredient, such as cereals known as fillers or extenders. Other ingredient have considerable water holding capacity (binders) e.g. egg yolk, skim milk powder peanut etc. and their ability to form irreversible gels on mild heating which serves to hold together the small pieces of meat.

Meat trimming can be added to lean muscle and fat some tissue can be included, only on restricted amounts because their texture can adversely affect the product. All the principles of processing and preservation methods of meat are based on the factors affecting microbial activity in meat. They include extrinsic factors such as temperature, relative humidity, the availability of oxygen and physical state of meat. The intrinsic factor such as water activity (aw), pH, oxidation-reduction, potential the presence of inhibitory substance, protective tissue and nutritive value of meat (Judge *et al*, 1999), processed meat is generally manufactured from bovine meat although meat from cameloids, sheep and version is also used. The best meat suited for processing is the meat of medium aged animals (Lawrie, 1990). Old animals in good nutritional condition can also be used for processing, but the higher amount of connective is likely to increase toughness. It's very important that raw material for manufacture of processed meat is examined carefully for undesirable alterations such as discoloration, hemorrhagic spots, off odors, manifest of parasites. Such defects must be trimmed off (FAO, 1990).

2:18 Meat emulsion

Finely chopped meat mixture consisting of solid fat particles dispersed in a mixture of water and many fibrous particles including connective tissue and muscle fibers. e.g. of meat emulsion is bologna or wieners which have fine meat particles that they are not distinguishable on the smooth product surface. (Kinpe, 1992).

(Tibin and Babiker ,1986) found that camel emulsion type sausage with 10 and 15 percentage fat were organoleptically acceptable to Sudanese panelist and did not differ significantly, from beef and camel sausage weren't significantly different in their protein content both containing about 18%, cooking losses were not significantly different.

2:19 Food Additive

Any substances or mixture of substance other than the basic food stuff which is present in food as a result of any phase of production, processing, packaging or storage Food additives can be either used directly as the lemon flavoring added to cookies or indirect, as trace amounts of packaging materials that migrate to the food during processing or storage (FDA/WHO, 1991). Spices act on the salivary and gastric glands to promote secretion, stimulating appetite and improving digestibility of meat product. Their use varies according to climate, customs and eating habits (FAO, 1991). Spices provide in some instance bacteriostatie and anti-oxidant properties. Either natural spices or the oil spices are used most frequently for dry and semidry meat products. (FDA/WHO, 1991) Natural spices may contain a high bacterial content by their nature of storage conditions. Spices commonly used in Sudan include redpeper, coriander, ginger, garlic and cinnamon as reported by

(Pearson and Tuber, 1984). Extruded soy protein (ESP) are often used in manufacturing burger type products, They should be hydrated in water (7°C for 35-40 minutes) in the ratio of ESP to water of 1:1 or 1:2 or 1:3 . Salt, seasoning and dry or fresh onions are the basic ingredients (FAO, 1991).

2:20 Salt

Common salt (Sodium chloride) has three major effects on meat product it enhances flavor, solubilizes proteins to create desired texture and control microbial growth to enhance shelf life and inhibit pathogens (Ingram and Kitchell, 1967 and TerrelCHAPTER THREE

MATERIALS AND METH

3:1 Experimental Meat

3:1:1 Source of meat

The loin cut from both camel and beef were purchased from Abuzaid meat market to obtain twenty five kg of meat (12.5Kg camel mea and12.5Kg beef). 2.5 kg of kidney fat (beef) from the same beef animals were also purchased. These samples were transported hygienically to the meat laboratories in the Department of Meat Production, Faculty of Animal Production at Shambat (Khartoum North), University of Khartoum.

3:1:2 Samples preparations**:**

The loin cut samples were deboned and the meat obtained were weighed and labeled properly kept in a plastic bag and frozen until used.

3:2 Burger formulations

The ingredient required to manufactured the burgers according to FAO (1991) is shown in table (1). Meat and fat for each of the treatment groups were run separately through an electrical meat grinder, the meat through 8mm plate and the fat through 6mm plate. Sample from the meat were used for the proximate analysis as described by AOAC (1990). Then the rest of the meat and the other ingredients were thoroughly mixed by hand and the mixture was regrinded through a 5mm plate and finally burgers were formed, weighing 100gm and 5-10mm thick. After freezing, the burgers were packed into suitable plastic bags, and immediately transported to storage at -18℃ till used for analysis.

Table (1) Burger Formula

Ingredient	%
Meat(beef&camel)	62
Soy bean 1:1	20
Bread crumbs	2.5
Kidney fat	10
Salt	2
Onion	2
Seasoning	1.5
Total	100

3:3 Chemical Proximate analyses:

Determination of total moisture, ash, total protein and fat (ether extract) were performed according to AOAC (1990) methods.

3:3:1 Water holding capacity (WHC)

Duplicate samples (about 1 gm) from the minced muscles (LD, SM, and ST) were used. Each sample was placed on humidified filter paper (Whatman No.4 in desiccators over saturated KCl solution) and pressed between two plexiglass plates for 1 minute at 25 kg/cm^2 load. The meat filter area was traced with a ball pen and the filter paper was allowed to dry. Meat and moisture areas were measured with a compensating planometer. The resulting area covered by the meat was divided into the moisture area to give a ratio expressed as water holding capacity of meat. A large ratio indicates an increase in the watery condition of the muscle or a decrease in the water holding capacity (Grauard and Hamm, 1953).

$$\textit{Water holding capacity (WHC)} = \frac{\textit{Loose water area- Meat film area}}{\textit{Meat film area}}$$

3:3:2 Cooking loss and shrinkage

Samples were trimmed of all external fat and connective tissues. They were cut into portions 5x5x7 cm with the fibre direction parallel to the long axis. Each sample was placed in a polythene bag and totally immersed in a water bath at 80ºC for 90 minutes (internal temperature at the centre of sample was 80ºC). After cooking each sample was cooled in running tap water for 20 minutes in its exuded fluids and then removed and dried with paper towel (Bouton et al., 1978) Cooking loss was determined as the difference in weight of sample before and after cooking, and was expressed as a percentage of the weight before cooking.

$$\textit{Cooking loss} = \frac{\textit{Wt. Before cooking - Wt. After cooking}}{\textit{Wt. Before cooking}}$$

The frozen burger samples were weighed and their diameters were measured and cooked in a pan using vegetable oil at constant temperature (90ºC) for 5 minutes with continuos turning of the samples. The cooked samples were freed of the oil using absorbent kitchen paper and allowed to cool, weighed The difference in weight of samples before and after cooking was recorded as the total cooking loss and expressed as a percentage of weight before cooking. The same samples were used for shrinkage determination. The meat film area was traced with a ball pen before and after frying . The filter paper was allowed to dry and areas were measured.

$$\text{Shrinkage} = \frac{\textit{area before cooking - area after cooking}}{\textit{area before cooking}} \textit{X100}$$

3:4 Objective color measurement

The color of fresh sample of camel meat and beef, and the external color of burger products before and after storage, were determined using a Hunter Lab Tri-stimulu Colorimeter ModelD25.L, optical sensor machine. Lightness (L), redness (a) and yellowness (b) measurements were determined. It was standardized with the white calibrated standard NoC_2 136 (L = 93.4, a = -101 and b = -1.9).

3:5 Ultimate PH

Ten gram of each sample were blended with 20 ml distilled water in a blender for 30 s and pH value of fish homogenate was measured by a digital pH-meter (HM-5 S; TOA Electric Industrial Co. Ltd., Tokyo, Japan) standardized at pH 7

3:6 Oxidative rancidity measurements

The oxidative rancidity of the muscles samples was determined using 2-thiobarbituric acid (TBA) method as described by *Hoyland and Taylor (1989*) the method employed was as follows:

A) Preparation of samples:

1- A 3g of meat sample was weighed.

2- 50 ml of distilled water was added.

3- The mixture was homogenized in a micro- blender jar for 5 minutes.

4- The homogenized sample was transferred to Kjeldhal flask.

5- The blender jar was washed with 47.5 ml distilled water to remove all the remaining of the homogenized meat

6- 2.5 ml of 4N HCl was added.

7- The kjeldhal flask was put on distillation apparatus and heated at high temperature after the addition of anti-foaming granules.

8- A 50 ml was collected by distillation.

B) TBA Preparation:

1- 0.2884 of TBA was weighed.

2- 100 ml of glacial acetic acid was added.

3- Then dissolved with heating.

4- 5 ml was taken from the sample after shaking and added to 5ml of TBA.

c) Blank Preparation:

The blank solution was prepared from 5 ml of distilled water +5 ml TBA solution.

D) Final preparation of the sample solution:

1- The flask containing sample solution (5 ml of the sample +5 ml of TBA) was covered with aluminum foil.

2- The flask was heated with the vapor of water bath for 35 minute.

3- Then cooled for 10 minutes.

4- The reading of oxidative rancidity was taken using a spectrophotometer at the wave length of 538 nm.

Calculation:

$$\textit{Oxidative rancidity (mg /ml)} = \frac{\textit{Spectrophotometeric Reading}}{\textit{Sample Wt}} \times 7.8$$

3:7 Sensory evaluations

Sensory panel evaluation was conducted with a 10-semitrained as described by Parrish *et al*. (1973). Samples were thawed overnight at 4ºC and roasted, wrapped in aluminum foil, in an electric oven at 175˚C to an internal temperature of 75˚C. Semi-trained panelists evaluated warm meat samples in individual booths. Panelists evaluated each meat sample for tenderness, flavor, juiciness and acceptability using an 8-point scale score (hedonic scale) card as described by Cross *et al.* (1978). The highest score of 8 being extremely colorful, tender, textured, flavorful, juicy and acceptable and the least score of 1 is extremely poor in color, tenderness, texture, flavor, juiciness and overall acceptability (Appendix, 1). Tap water was available for use between testing samples.

3:8 Statistical Analyses

Data for experiment 1 were analyzed using analysis of variance. Data for experiment 2 were analyzed as a completely randomized design with a 4x4 factorial arrangement of treatments using analysis of variance treatment means were compared by Duncan's multiple range tests by using SPSS version 10.05-compu

CHAPTER FOUR

RESULTS

4:1 **Comparison between Fresh Camel and Beef Meat**

4:1:1 Chemical Composition

Chemical composition of camel meat and beef are presented in table (2). The chemical composition of camel meat and beef were significantly different ($P<0.05$). Camel meat samples had the highest percentage of moisture and least protein , fat and ash percentage compared with beef .The moisture, protein ,fat and ash content of camel meat were 75.06%, 20.68%,1.5 %, and 1.18% ,while those of beef muscle were 72.40% ,21.52 %,3.94% and1.36% respectively.

4:1:2 Ultimate PH

Mean values of camel meat PH and beef meat are shown in table (3). PH value of fresh camel meat (5.62) was significantly higher (p<o.o5) than that of beef meat (5.46).

4:1:3 Water Parameters

4:1:3:1 Water holding capacity:

Water holding capacity of camel meat and beef are presented in table (3). The water holding capacity of camel meat (2.08) was significantly superior ($p<0.05$) than that of beef meat (2.64) These result showed that camel muscle were superior to beef in water holding capacity .

4:1:3:2 Cooking Loss:

As shown in table (3) cooking loss of camel and beef meat are significantly different ($p<0.o5$). Cooking loss value of fresh camel (31.28) was lower than that of beef meat (39.78).

Table (2): Chemical Composition of Camel Meat as Compared with Beef

Parameter	Beef Meat	Camel Meat	SE	LS
Moisture	72.40	75.06	0.15	***
Protein	21.52	20.68	0.09	NS
Fat	3.94	1.50	0.08	***
Ash	1.36	1.18	0.09	NS

In this and subsequent tables

*:p<0.05.

**:p<0.01.

***: p<0.001.

NS: Non-significant.

SE: standards error of the mean

Table (3) Comparison between Camel and Beef Meat on Physical Parameter

Parameter	Beef Meat	Camel Meat	SE	LS
W H C	2.62	2.08	0.05	***
Cooking loss	39.78	31.28	0.97	***
PH	5.46	5.62	0.05	*

4:1:4 Objective Colors

Figure (1) shows that color of fresh camel and beef muscle were significantly different (p<0.o5). Camel meat had more lightness (L, 28.16), redness (a, 18.56) and yellowness (b, 8.18) values than beef meat (L, 26.06), (a, 14.18) and (b, 6.60).

4:2 Effect of adding different levels of camel meat and storage time on burger composition and quality.

Staticall analysis revealed that there were significant interaction between the added different levels of camel meat and storage time in the protein, fat, ash, PH, water holding capacity and color (L).While the moisture content, cooking loss, shrinkage, oxidative rancidity, color and panel test shows no interaction between treatments

4.2 Effect of storage time on burger quality obtained from different levels of added camel meat

Table (4&5) shows effect of different levels of added camel meat on chemical composition changes of burgers stored for 7 days at -10^0C.

4.2:1 Chemical composition

The effects of using different percentage on burger chemical composition are presented in table (4). Increasing the level of camel meat from level one to four resulted in a highly significant (p <0.05) increase in moisture percentage, and decrease from day one (63.63%) to day 7 (62.64%) of storage time (table 5). The control (0 level) was highly significantly (p <0.001) lower in moisture percentage 61.88 than 25, 50, 75and 100% treatments. The 25(63.01%), 50(63.38%) and 75(63, 41%) percentage were not significantly different (p>0.05).the 100% camel meat the control (0 level) was highly significantly ($p < 0.001$) higher in moisture percentage 64.01 than 0, 25, 50, and 75% .

4.2:2 Cooking loss and shrinkage

Mean values Cooking loss and shrinkage of burgers from samples of different levels of camel meat, stored at -10^0 C for up to 7days, are shown in table (4&5), with the exception of level 0 and 4 in cooking loss of burgers from different level of camel meat were not significantly different ($p>0.05$). The control (0) showed the highest cooking loss(31.34%) and shrinkage(19.61%) while level 4 had the lowest cooking loss (28.98%) and shrinkage (17.42%) . cooking loss and shrinkage decreased significantly ($p<0.001$) with increaseing the storage time from 1 to 7days. the 25,50 an75% samples had cooking loss values of 31.17,30.29,29.46and shrinkage values of 18.38,17.68 and 17.54 respectively.

4.2:3 Oxidative rancidity:

The Effect of different percentage of camel meat on oxidative rancidity (TBA value) of burger stored at -10^0 C for 7 days is presented in table (4&5) as seen oxidative rancidity value was significantly ($p<0.01$) affected by the level of camel meat the control showed the highest (TBA-value) .levels 3 and 4 showed the lowest TBA- values. Thus the oxidative rancidity decreased significantly with increasing level of camel meat but this decreased was not significant between level 2, 3 and4 also between levels 2 and 1. TBA-values were 0.11, 0.1, 0.09, 0.08 and 0.08 for levels 0, 1, 2,3and 4 respectively. Increasing keeping time to 7days resulted in a highly significant ($p<0.001$) increase in oxidative rancidity. TBA-values were 0.05 and 0.14 at day one and day 7 respectively.

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Table (4) Effect of adding different levels of Camel meat on burger Chemical analysis:

Parameters	Treatment					SE
	0	1	2	3	4	
Moisture	61.88[a]	63.01[b]	63.38[b]	63.41[b]	64.01[c]	0.19
Cooking loss	31.34[c]	31.17[bc]	30.29[bc]	29.46[ba]	28.98[a]	0.60
Rancidity	0. 11[a]	0.1[ab]	0. 09[bc]	0.08 [c]	0.08[c]	0.1
Shrinkage	19.61[a]	18,38[a]	17.68[ab]	17.54[b]	17.42[b]	0.48

Treatment:

0=100%beef (control) 1.2.3 and 4 Treatment:

0=100%beef (control) 1=25% of camel meat, 2=50% of camel meat, 3=75% camel meat, 4=100% camel meat.

Table (5): Effect of Storage Time on Burger Parameter

Parameter	Storage time (days)		SE
	1	7	
Moisture	63.63	62.64	0.12
Rancidity	0.05	0.14	0.00
Cooking loss	31.37	29.38	0.38
Shrinkage	19.34	16.91	0.30

Table (6): Effect of adding different level of Camel meat and storage time on Beef burgers Chemical Composition:

Parameter	Storage Time(days)	Treatment 0	1	2	3	4	SE
Protein	1	22.82^{d}	22.23^{c}	22.13^{c}	21.26^{a}	21.58^{b}	0.4
	7	21.71	21.51	21.46	20.37	20.60	0.4
Fat	1	8.82^{d}	7.13^{c}	7.12^{b}	6.24^{a}	6.22^{a}	0.05
	7	7.89	6.78	6.63	5.87	5.76	0.05
Ash	1	2.15^{cd}	2.16^{a}	2.13^{ab}	2.14^{bc}	2.16^{d}	0.01
	7	2.13	2.13	2.11	2.12	2.14	0.01

4.2:4 PH measurement:

Table (7) shows effect of different level of camel meat on burger pH are high significant ($p<0.05$) PH increased with added different level of camel meat in 0 and levels 1 ph was 5.24 ,5.18 and increased by added different level of camel meat 5.40.5.46 and 5.72 level 4.during storage time for 7 days at -10^0 C. PH values decreased insignificantly ($p>0.05$) from o level 4.32 to4.36.4.39,4.40 and 4.42 with increasing different level of camel meat and storage period .This indicates that level 4 had slightly higher pH values.

4.2:5 Water parameters

4.2:5:1 Water holding capacity

As seen in table (7) whc of burger manufactured from different level of camel meat and stored at -10^0 C for up to 7 days. The WHC of burger was higher significant ($p<0.005$) from level 0 1.48 and 1.28,11.38,1.78 and1.88. during storage time the whc improved insignificantly with increasing storage time up to 7days . The water holding capacity of the 0 level 0.75 and 0.53,0.55,0.63 and 0.68 from level 1,2,3 and 4 respectively.

Table (7): Effect of Adding Different Level of Camel Meat and Storage Time at -10c on Beef Burgers Physical parameter

Parameter	Storage Time(days)	Treatment 0	1	2	3	4	SE
PH	1	5.24^{a}	5.18^{ab}	5.40^{bc}	5.46^{bc}	5.72^{c}	0.07
	7	4.32	4.36	4.39	4.40	4.42	0.07
W H C	1	1.48^{b}	1.28^{a}	1.38^{a}	1.78^{bc}	1.88^{c}	0.07
	7	0.75	0.53	0.55	0.63	.68	0.07
Lightness (L)	1	37.16^{b}	36.24^{a}	38.04^{b}	36.78^{b}	37.52^{c}	0.53
	7	37.70	33.02	34.33	35.24	37.00	0.53

4.2:5:2 Objective Color Measurements of Burger:

Color measurements of burgers manufactured with different levels of camel meat are presented in figure (3). As seen color co ordinates –a-(redness) and b-(yellowness) increased in significantly ($p>0.05$) with increasing level of camel meat. Level (0) showed the lowest a (15.14) and b(11.11) values while level 4 showed the highest a(16.24) and b (11.23).

These results indicated that burger of treatment (4) appeared brighter in color. The a-(redness) and b-(yellowness) colors values decreased significantly ($p<0.05$) with increasing the storage time .day 1had the highest a-(16.45) and b-(11.84) values compared with 7days (a- 13.85and b- 10.47).

On the other hand, as seen from table (7), there is significant interaction ($p<0.05$) effect between the added level of camel meat and the storage time on burger lightness (L). At day one to day seven of storage time treatment (4) showed the highest lightness values (36.24 and 38.04 respectively) in comparison with treatment (0) which showed the lowest lightness values(33.02 and 37.70 respectively) This indicated that increasing the added level of camel meat is affect by increasing the storage time. This means that the highest level of camel meat resulted in more lightness with increasing storage time.

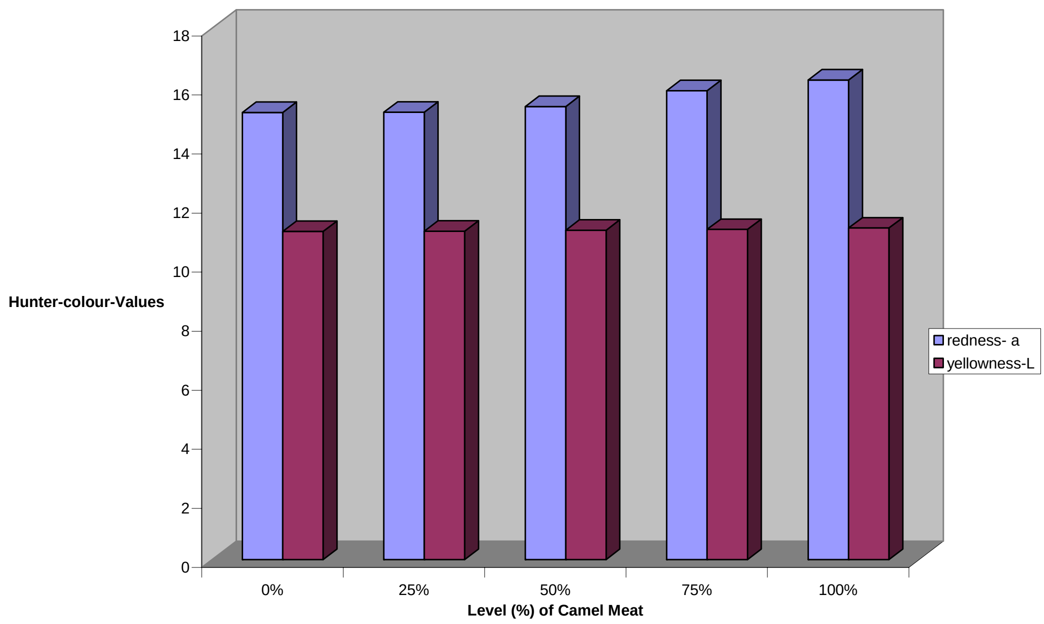

Figure 2: Effect of Different Levels (%) of Camel Meat on Burger Colour Colour

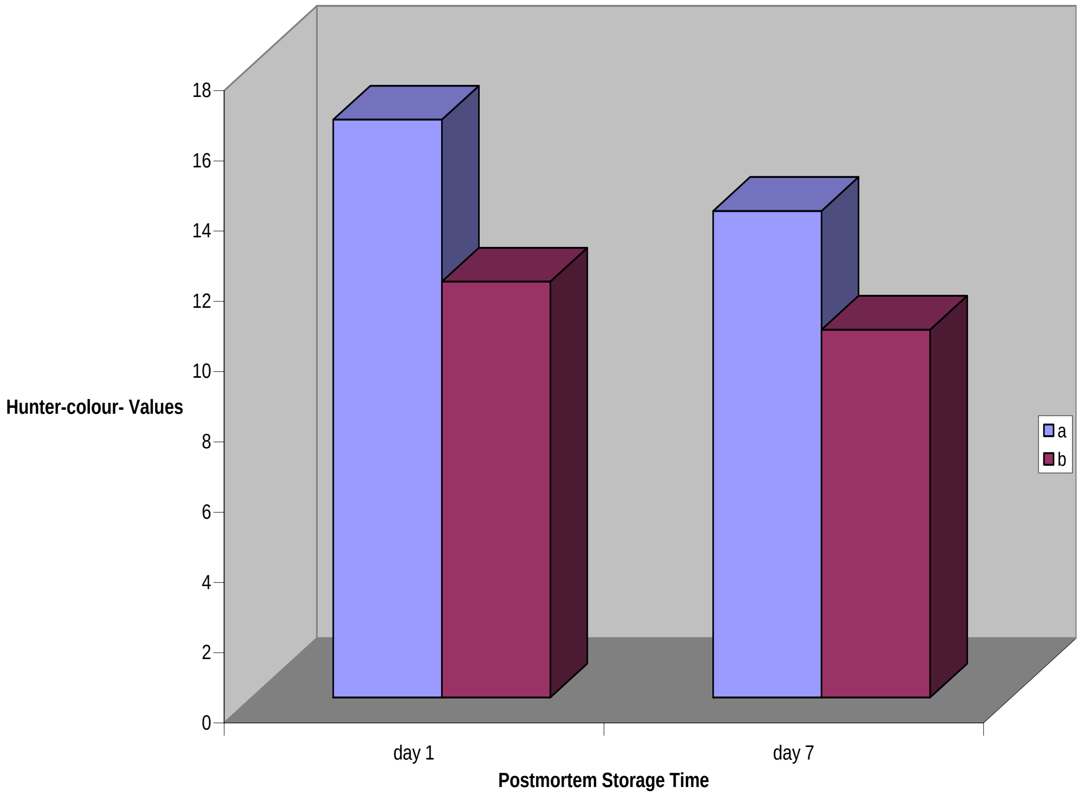

Figure 3 : Effect of Postmortem Storage Time on Burger Colour

4:2:6 Sensory Evaluations

Sensory evaluation of burgers manufactured with different levels of camel meat and kept at -10C for 7 days are shown in tables (8&9). The result show that the panel scores for the, tenderness, flavor, juiciness and color were not significantly ($p>0.05$) with increasing the added level of camel meat. The increase was insignificant between treatment 0,1 and 3. treatment 3 and 4 differed significantly ($p<0.05$) from each other treatment 0,2 and 3. The 100% camel meat sample had the higher scores compared with the (0) which showed the lowest panel score. Tenderness and color decreased slightly insignificantly ($p>0.05$) but flavor and juiciness increased slightly insignificantly ($p>0.05$) with increasing the storage time from one to seven days at -10C.

Table (8): Effect of adding different levels of Camel Meat and Beef burger Panel Test:

Parameter	Treatment					SE
	0	1	2	3	4	
Tenderness	5.77^{a}	5.99^{a}	6.25^{a}	7.16^{b}	7.92^{c}	0.17
Flavor	6.10^{ab}	5.79^{a}	6.16^{ab}	6.30^{ab}	6.52^{b}	0.19
Juiciness	6.17^{a}	6.07^{a}	6.40^{a}	6.90^{a}	7.27^{b}	0.16
Color	5.80^{a}	5.91^{ab}	6.09^{ab}	6.30^{b}	6.76^{c}	0.16

Table (9) Effect of postmortem storage time on Beef burgers sensory evaluation

Parameter	Storage time		SE	LS
	1	7		
Tenderness	6.73	6.50	0.10	NS
Flavor	6.14	6.20	0.12	NS
Juiciness	6.38	6.45	0.10	NS
Color	6.19	6.15	0.10	NS

CHAPTER FIVE

DISCUSSION

5:1Camel meat and beef quality

5:1:1Chemical Compositing

The proximate chemical composition of the camel and beef, were found within the range determined by Babiker and Tibin, (1986) who reported that the moisture was higher in Camel than beef but fat was lower than beef. These results were similar with those of Babiker andYousif (1990) who studied the chemical composition of three muscles (L. dorsi, Semitendinosus and Triceps brachii) obtained from mature well finished desert camel and found that the moisture percentage was (75.89), (75.81) and(75.23) , the protein percentage was (21,63), (21.41) and (21.41), and fat percentage was (1.43),(1.40) and(1.42), and the ash percentage was (1.05), (1.38) and(1.22) for the three muscles respectively. The Variation in chemical and biochemical constitutions of muscle are affected by different factors such as bread, sex, age, species, and anatomical location of muscle and plane of nutrition. The chemical composition of camel meat compared with other species (beef, lamb, goat and chicken) showed more moisture, less fat, ash and similar protein content among the age groups (Lawrie, (1991) (Suad, 1994) Dawood and Alkanahal, (1995).

5:1:2Ultimate PH

PH value of camel meat was higher than that of beef .This could be due stressed for long duration during camel slaughtering. These results agreed with those reported by FAO, (1991) and Guingnot et al, (1992) in that, after slaughter the glycogen in muscle is converted into lactic acid causing a fall in PH from an initial value of (7.3-6.8) to about (5.8-5.4) . Ph changes after slaughter are largely governed by the amount of glycogen available for transformation into lactic acid. These results were more or less similar to the findings of other workers Babiker and Yousif (1990) and Fathi Elrhman ,(2005) who reported that the ultimate PH value of camel meat was high(5.73) than beef (5.46).

5:1:3Water holding parameters

The results showed that the water holding capacity of camel meat was higher or superior than that of beef. These results agreed with those reported by Babiker and Tibin, (1986), Babiker and Yousif, (1990) and Fatih El-rhman, (2005) who reported that the WHC of camel meat was superior to that of beef and that superiority explained adaptation ability of camel to its dry habitat. Camel meat had less cooking loss than beef meat. This could be due to its high WHC and low fat content. These agree with (Babiker and Tibin, 1986) who report that camel meat sample have less cooking losses and higher water holding capacity when compared with beef samples. There also agree with (lawrie, 1991) who noticed that higher water holding capacity of meat decreased cooking loss in final product.

5:1:4Objective color

Camel meat had more lightness (L), redness (a) and yellowness (b) values than beef muscle. These results indicated that camel meat appeared brighter red than beef. This may be due to the variation in the level of pigmentation (myoglobin) present in the muscle lawrie,(1990) and Valin et al. (1992) found that the color of meat product depends mainly on concentration of muscle pigment, and curing agents used in meat products such as sodium nitrite and common salt. These results were in conformity with those by Babiler andYosif (1990) and Fathi El-rhman, (2005) who reported that camel meat color varied from raspberry red to brown.

5:2 Quality attributes of burgers with different levels of camel meat and stored at -10C for 7 days

5:2:1Chemical composition

The chemical composition of burger made of different percentages of camel and beef meat are investigated. The result indicated that the burger made from with camel meat (treatment 4, 3 and 2)had similar values of protein and moisture content than burger made with beef burger treatment (1) storage of burger for 7 days at -10^0c the protein ,moisture and fat significant decreased($p<0.05$)

The recipes were similar except for the different percentages of camel and beef meat. Addition of soybean had excellent protein for increase percent of protein, due to different chemical composition of the soybean.

Ph measurement:

PH values of different percentage of camel meat manufactured burger were significantly differed ($p<0.05$) with increasing percentage of camel meat during storage periods. In table (8) This ph values decreased slightly with increasing different percentage camel meat on the storage time from day 1today 7 at -10^0c .these agree with (Van den Beg et al, 1961) who reported that changes in ph during freezing might be caused by the increase in concentration of soluble materials, by the subsequent precipitation of salt, and probably by the interaction of protein with ionic substance. also conformity with (Babiker and Yousif,1990) and agree also by (Fathi El-rhman ,2005) who reported that the ph level of frankfurters packaged by different packing methods .at zero period of storage the ph value of 5.87, was significantly($p<0.05$) increased to 6.20 and 6.27 for vacuum and atmospheric packaged frankfurter after 42 days of storage.

Water holding capacity:

The water holding capacity of the burger of camel and beef meat were significantly differ ($p<0.05$) .these results show that improvement in WHC with increasing different percentage of camel meat during storage time for all treatment studies. The results agree with other workers (Saliha, 2000). Who reported that water holding capacity of camel muscle decreased from 5.58 at zero hour to 3.58,2.82and 2.12 at 3,5 and 7 days of storage respectively.

The result indicated that camel meat was superior to beef and had acceptable function properties which allow manufacturing emulsion type products.

Cooking loss (frying):

Cooking loss % of burger during storage period for 7 days at -10^0c was investigated. cooking loss decreased significantly ($p<0.05$) with increased different percentage of camel meat .These results are in conformity with other workers (Babiker and Tibin,1986) and (Town et al,1971) who reported that the percentage of losses in cooking were affected by the level and type of fat in frankfurters .

(Krishan and Sharma ,1990) who reported that the difference in cooking losses of emulsion type sausage manufactured from buffalo meat with 15.20 and 25%pork fat , and also confirm with (Sofos,1983) reported that cooking losses increased as the salt level in the formulation decreased.

Oxidative rancidity:

Oxidative rancidity (TBA) of burger made with adding different levels of camel meat was investigated. Result showed (TBA-value) of different treatments had significantly higher ($p<0.05$) affected by freezing condition and increased with increasing different percentage of meat from day one to day seven. These agree with (Sato and Hegorty, 1971; Kerter and Grosh.1996) who reported that the process is relatively rapid (1-2 days), and this lead to the rather stale, rancid flavor referred to as warmed- over flavor. Also in conformity with (Fathi El-rhman, 2005), and (Warriess, 2000) who indicated that unsaturated fatty acid are very prone to oxidation, even in meat in which most of the fat is saturated as the cell membranes contain phospholipids.

Objective Color measurement:

Objective color measurement of fresh and storage burger from different percentage of camel meat. Color was affected significantly ($p<0.05$) with increasing different percentage of camel meat and storage time (treatment 4) had highest lightness, redness and yellowness values. Lightness (l),and redness(a) and yellowness (b) are decreased with increasing storage time from day one t seven at -10^0c this result was indicated by (Al-Qadi,2007) who pointed that with regard to color, camel meat sustains its redness up to five days of storage, also inconformity with (Fathi El-rhman 2005).

Sensory evaluation

Results of sensory evaluation of different percentage of camel meat made burger, that storage from day one to day seven at -10^0c show that panel score for color, tenderness juiciness, flavor and overall acceptability were in significant different ($p>0.05$) for all treatment during storage which supported by (Babiker and Tibin,1986) who reported that, flavor of sausage prepared with camel meat and beef with two fat levels (10and 15%) were accepted by panelists. result of panelist juiciness indicated that camel meat burger received higher juiciness scores compared with beef burger . this result in a lower cooking loss of camel meat burger. Thus, burger made with camel meat retained their water and fat during cooking better than those made with beef. This explain the fact that burger from camel meat were juicier than beef burger. These results might be due to the superiority of functional properties of camel meat compared with beef. These are support to the results by (Johnson, 1946) who mentioned that, differences in juiciness were related primarily to the ability of muscle to retain water during cooking. Also, the higher juiciness scores of camel meat burger might be due to the lower cooking loss compared with beef burger, which received lower score and higher cooking losses. Also conformity by (Deatherage, 1963) who reported that the sensation of tenderness is influenced by the juiciness of meat, the water holding capacity of protein and the amount and distribution of fat.

Chapter SIX

Conclusion

Results indicated that burger manufactured from different levels of camel meat and beef affect positively its processing characteristics and meat quality.

The study was carried on burger made from different levels of camel meat 25kg each one 12.5kg of camel and beef meat divided into 5groups according to individual levels (0%, 25%,50%,75%,100%) chemical and physical composition, water holding capacity, cooking loss, PH and meat color. Also preparation fresh camel meat burger was prepared and its chemical composition, (whc), rancidity, cooking loss and shrinkage, color and sensory evaluation were determinate. Results showed that increasing level of camel meat resulted in less moisture % and less protein ,fat increasing different level of camel meat to 75% of camel meat were superior in moisture % less fat, cooking loss, shrinkage ,improved whc , decreased TBA-values . During storage time rancidity was increased in 7 days in all levels, cooking loss and shrinkage decrease. Whc was improved, ph was decreased during 7 days, and color showed some changes during storage. Sensory evaluation of fresh burger that there was no change in tenderness flavor juiciness and color during storage for all treatment. Burger made with different camel meat have good processing characteristic and quality .Result of test panel reveal that burger product prepared from camel meat were acceptable, off-flavor compounds were not present. From all result the 75% of camel meat was led to improved whc and cooking loss and shrinkage.

Further more it can resist processing manipulation and freezing.

Data of processing camel products was lacking. So we need more studies and research on this field, camel meat was commonly used roasted food in part of Sudan.

CHAPTER SEVEN

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Appendix

Table (10) Color Values of Camel and Beef Meat.

Parameter	Beef Meat	Camel Meat	SE	LS
Lightness (L)	26.06	28.16	0.37	**
Redness (a)	14.18	18.56	0.40	***
Yellowness (b)	6.60	8.18	0.30	**

Table(11) :Effect of Storage Time on Burgers Color

Parameter	Storage time (days)		SE	LS
	1	7		
Redness-a	16.45	13.85	0.38	***
Yellowness-b	11.84	10.47	0.15	***

Table(12): Effect of Adding Different Levels (%) of Camel Meat on Burgers Colors

Parameter	Treatment					SE	LS
	0	1	2	3	4		
Color(a)	15.14	15.15	15.34	15.88	16.24	0.59	NS
Color(b)	11.11	11.12	11.15	11.18	11.23	0.24	NS